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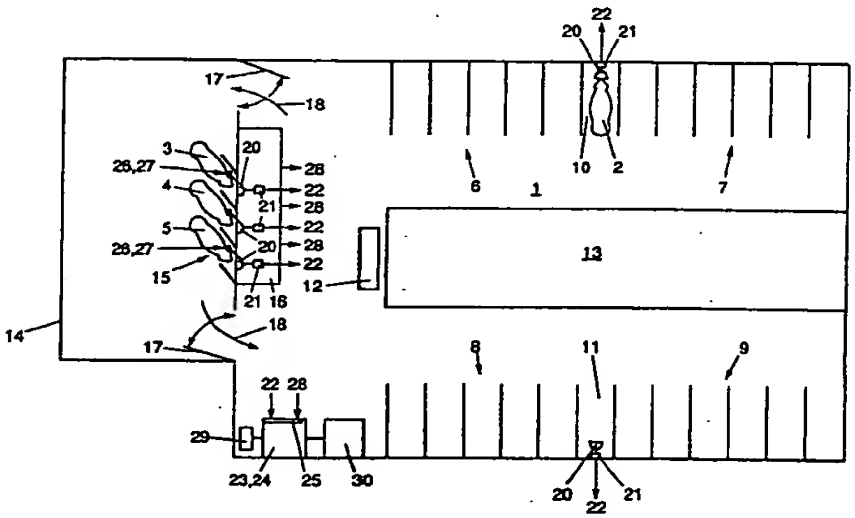
(54) Information system and method for automatically obtaining data about animals in dairy farming.

(57) The system comprises a processing device with an input gate to which signals can be fed which comprise information about a milk flow during the milking of an animal or group of animals. The processing device derives data from the signals, stores the data and processes them further. According to the invention, the processing device determines deviations in the data in relation to predetermined milk flow characteristics of the relevant animal or the relevant group of animals and/or changes in the milk flow characteristics and it signals an animal or group of animals in which the deviations and/or changes exceed predetermined values for the purpose of watching the reproductive status and/or health status of the relevant animal or the relevant group of animals.



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This invention relates to an information system for automatically obtaining data about animals in dairy farming, which comprises a processing device with an input gate to which signals can be fed which comprise information about a milk flow during the milking of an animal or a group of animals, and in which the processing device derives data from these signals, stores these data and further processes them.

Such a system is disclosed in U.S. patent 5,152,246. During automatic milking, this system measures the milk flow from the udder of a cow with a view to automatically stopping the milking timely.

In accordance with the invention, the processing device determines deviations in the data in relation to predetermined milk flow characteristics of the relevant animal or the relevant group of animals and/or changes in these milk flow characteristics, and signals an animal or a group of animals in which the deviations and/or changes exceed predetermined values, for the purpose of watching the reproductive status and/or health status of the relevant animal or the relevant group of animals. In accordance with the invention, therefore, data regarding the milk flow are used to give indications with regard to the fertility status and the health of the milk-yielding animal. By statistically processing these measured values, changes in the milk flow characteristics or deviations from those characteristics can be traced by the information system and be made known. The purpose of the information system is to support the dairy farmer in managing his stock.

In particular, the milk flow characteristics mentioned comprise an expected value and a maximum permissible deviation. Then, for instance, the difference between the received data and the expected value can be determined. If the difference is greater than the maximum permissible deviation, the animal or the group of animals is signalled by the system. A farmer can then investigate, for instance, whether the animal is ill or establish that the animal is fertile.

More particularly, the processing device processes the above-mentioned signals into statistical information for obtaining the milk flow characteristics mentioned. Thus a so-called self-learning system is obtained. The processing system can for instance determine an expected value of the data in question for the purpose of obtaining the milk flow characteristics. On the other hand, it is of course also possible for the milk flow characteristics to be stored in the system a single time, for instance on the basis of generally known information about these characteristics.

More particularly, the processing device comprises, or is coupled to, a signalling device which is capable of signalling deviations between the milk flow characteristics on the one hand and the received data on the other which are greater than predetermined permissible deviations and/or is capable of signalling changes in the milk flow characteristics which are greater than predetermined permissible changes. A change in the milk flow characteristics can for instance be established by continuously adjusting the expected value on the basis of new data. If this expected value is subject to a sudden substantial change, something unusual appears to be going on.

The signalling device can for instance generate an output signal when a deviation is greater than the permissible deviation and/or a change is greater than the permissible change. This signal can be an observable signal to alert a farmer, for instance. However, the signal can also be a control signal by which a particular device is activated, for instance an automatic gate which is opened to guide the animal in question to a different space.

According a possible embodiment of the system, the data relate to the time interval between the application of a milk cluster of, for instance, a milking robot, and the beginning of the milk flow from the udder of an animal which is being milked by the milking robot.

It is further possible for the data to relate or additionally relate to the time interval between the beginning of the milk flow and the end of the milk flow during the milking of the animal. Similarly, it is possible for the data to relate or additionally relate to the maximum flow rate in a subinterval of the milk flow period. The milk flow period can for instance be defined as the time interval between the beginning of the milk flow and the end of the milk flow during the milking of the animal. Here, milking can again be carried out with the aid of a milking robot, which is known per se.

In addition, the data may also relate to the amount of milk which has flowed on average during the milk flow period and/or the variation in the milk flow in time during the milk flow period. An example of the latter option would be the change in the flow rate per unit time.

According to a particular aspect of the invention, the processing device may further comprise one or more input gates to which other parameters regarding each individual animal or group of animals can be fed. In such cases, the processing device can process the signalled deviations and/or changes in combination with the other available parameters, such as feed intake, milk yield, temperature, animal activity, milk conductivity and water intake.

According to a preferred embodiment of the system, the system further comprises a milking robot for automatically milking the animals, the

milking robot comprising means for generating the signals representing the milk flow during the milking of an animal or group of animals. These signals are then entirely automatically fed to the processing device and processed further. However, it is also possible for the signals to be inputted in a different manner or from a different source, for instance with the aid of a keyboard.

According to the invention, a method for automatically obtaining data about animals in dairy farming, in which signals comprising information about a milk flow during the milking of an animal or group of animals are fed to a processing device, and the processing device derives data from the signals, stores the data and processes the data further, has as a characteristic feature that deviations in the data in relation to predetermined milk flow characteristics of the relevant animal or the relevant group of animals and/or changes in these milk flow characteristics are determined, and an animal or group of animals is signalled for the purpose of watching the reproductive status and/or health status of the relevant animal or the relevant group of animals when the deviations and/or changes exceed predetermined values.

The invention will be further explained with reference to the single drawing. The single drawing shows a stable layout comprising a possible embodiment of a system according to the invention. The example shown concerns a stable 1 for milk cows. A few cows are schematically indicated at 2, 3, 4 and 5. The stable shown comprises a number of cubicles 6, 7, 8, 9; feeding stations 10, 11; a drinking station or drinking trough 12; and a feeding floor 13 where the roughage for the animals is deposited. The stable further comprises a milking parlor 14 with a number of milk stands 15, where the cows, such as the cows 3-5, can be milked with the aid of a milking robot 16. The milking parlor joins the rest of the quarters by way of passages 18, which in this example are equipped with gates 17.

In the example shown, the milking robot 16 is provided with antennas 20 which are connected with transceiver devices 21 arranged *in situ* or elsewhere. Further, the feeding stations 10, 11 are each provided with such an antenna 20 and a transceiver device 21.

If desired, antennas of transceiver devices can be arranged at more points, for instance at the drinking trough(s), in the cubicles, at the exit of the milking parlor, etc.

Each animal whose behavior is to be investigated is provided with a suitable identification means, such as for instance an electronic responder, which generates a code signal associated with the relevant animal as soon as the responder comes within reach of an antenna of a transceiver device. The transceiver device can recognize the received code signal, so that it can be registered at what time, how long and which animal or group of animals is present at a specific place.

On the basis of these data, visiting frequencies (the number of visits to a specific station per unit time, for instance per day), displacement patterns, etc., can be determined for each animal, and, if desired, reproduced. For that purpose, the transceiver devices can be connected with a suitable processing device 23 by way of lines 22. In this example, the processing device 23 consists of a computer 24 with an input gate 25. Also variations in the displacement patterns, visiting frequencies, etc., can then be determined and optionally reproduced.

The milking robot 16 is of a type which is known per se and accordingly comprises a number of milk clusters 26 which can be connected to the udders of the animals for automatically milking the animal. Further, each milk cluster 26 comprises a sensor 27 for measuring the milk flow from an udder of an animal during milking. The sensors 27 generate signals which represent these milk flows. These generated signals are fed to the input gate 25 of the processing device 23 by way of lines 28. Thus information about the milk flow of an animal during milking and the identity of the relevant animal is fed to the processing device 23.

The operation of the system which in this example comprises at least the processing device 23, the antennas 20, transceivers 21, and the sensors 25, is as follows.

On the basis of the data inputted in the processing device 23, the latter can produce information which can be used by the farmer when making decisions about his stock or about individual animals of his stock. At dairy farms it is normally of importance to have animals calve regularly at intervals which are not unduly long, whereafter a new peak in the milk yield can be attained. In order not to unduly prolong the intervals between calving events, the animals must be served/inseminated timely and at the proper time (when the animal is in heat). In particular the detection of the proper time of heat is of importance, since an animal is often in heat for only a few hours (6 to 18 hours) and then no longer so for a succession of days. A second important aspect in dairy farming is animal health. The information system is an important supporting tool for the dairy farmer since it can draw the farmer's attention to animals exhibiting characteristics that deviate from what may be expected, such as for instance, eating less than expected, being less active than expected, being less productive than expected, etc.

A particular feature of the present information system is that for watching the fertility status and

for watching animal health, use is made of the milk flow information. The processing unit 23 can derive *inter alia* the following information from the signals received from the sensors 25:

- false milking time: the time interval between the connection of the milk cluster 26 and the beginning of the milk flow from the udder;
- milk flow period: the time interval between the beginning of the milk flow and the end of the milk flow;
- flow rate: the amount of milk which has flowed on average during the milking period (amount of milk per unit time);
- maximum milk speed: the highest flow rate measured in a subinterval of the milking period, for instance the flow rate in the minute when the largest amount of milk has flowed from the udder;
- variation in the milk flow during the milking period. One animal will reach a high milk flow rapidly while another animal's milk flow may be slower to rise.

By means of statistical techniques, the processing unit 23 can determine an expected value of these data for each animal which is being milked, as well as a permissible deviation from this expected value. This expected value and this permissible maximum deviation in combination form a milk characteristic of the animal. In this example, the processing device is coupled with a signalling device 30, forming part of the information system, which is adapted to compare the expected value with the actual value of the measured data. If the difference is greater than the permissible deviation, the signalling device can detect animals exhibiting too large a deviation in the milk flow. The system can bring these detected animals to the farmer's attention, whereupon the farmer can undertake action. For this purpose, the signalling device can for instance generate a signal which can be observed by the farmer.

The second particular aspect of the present information system is that the milk flow characteristics are combined with other characteristics of the animal which are already being used in monitoring health and fertility, such as feed intake, animal activity, milk yield, milk temperature, and milk conductivity. The feed intake is for instance determined with the aid of the antennas 20 and the transceiver device 21 arranged at the feeding stations 11. Also data coming from external information suppliers can be included in this profile. This information can for instance be inputted with the aid of a keyboard 29 at the processing device 23. Through this combination it will be possible to give the reports of the system a higher reliability.

In this example, the processing device 23 processes the above-mentioned signals into statistical information for obtaining the milk flow characteristics. Thus a so-called self-learning system is obtained. The processing device 23 can for instance determine an expected value of the above-mentioned data for obtaining the milk flow characteristics. The distribution of the data can then be used for determining the maximum permissible deviation.

On the other hand, it is of course also possible for the milk flow characteristics to be stored a single time in the processing device 23 of the system with the aid of the keyboard 29 on the basis of, for instance, generally known information about these characteristics.

The signalling device is adapted to signal the deviation between the milk flow characteristics and the received data which is greater than a predetermined permissible deviation and/or to signal a change in the milk flow characteristics which is greater than a predetermined permissible change. The change in the milk flow characteristics can for instance be established by continuously adjusting the expected value on the basis of new data. If this expected value is subject to a sudden strong change, something unusual appears to be going on.

The signalling device can for instance generate the output signal when a deviation is greater than the permissible deviation and/or a change is greater than the permissible change. This signal can be an observable signal to alert the farmer, for instance. However, the signal can also be a control signal by which a particular device is activated, for instance an automatic gate which is opened to guide the animal in question to a different space.

In particular, via, for instance, the input gate 27 and/or the keyboard 29, other parameters regarding each individual animal or group of animals are fed to the processing device. The processing device can then process the signalled deviations and/or changes in combination with these other available parameters, such as feed intake, milk yield, temperature, animal activity, milk conductivity and water intake. It will be clear that the information fed to the processing device can originate from different sources and be inputted accordingly:

- manually, by the farmer/user;
- by coupling to data bases via modem, diskette or a different form of data carriers;
- by coupling to process control devices and transceiver installations, such as for instance feeding stations, weighing bridges, activity readers, milk conductivity meters, milk temperature meters, milk yield meters, milk flow meters, etc.

A further elaboration of the system is that the system not only reports signalled deviations but also controls peripheral equipment on the basis of

the signalled deviations. Thus it is possible for the information system, when the pattern of data is indicative of a condition of heat, to automatically call by way of the modem the computer of the institution for artificial insemination.

These and similar variants are all understood to fall within the scope of the invention.

Claims

1. An information system for automatically obtaining data about animals in dairy farming, which comprises a processing device with an input gate to which signals can be fed which comprise information about a milk flow during the milking of an animal or group of animals, and in which the processing device derives data from said signals, stores said data and further processes said data, characterized in that the processing device determines deviations in the data in relation to predetermined milk flow characteristics of the relevant animal or the relevant group of animals and/or changes in said milk flow characteristics, and signals an animal or group of animals in which the deviations and/or changes exceed predetermined values, for the purpose of watching the reproductive status and/or health status of the relevant animal or the relevant group of animals.

2. An information system according to claim 1, characterized in that said milk flow characteristics comprise an expected value and a maximum permissible deviation.

3. An information system according to claim 1, characterized in that the processing device processes said signals into statistical information for obtaining said milk flow characteristics.

4. An information system according to claim 3, characterized in that the processing device determines an expected value of said data for obtaining said milk flow characteristics.

5. An information system according to any one of the preceding claims, characterized in that the processing device comprises, or is coupled to, a signalling device which is adapted to signal deviations between the milk flow characteristics on the one hand and the data derived from the received signals on the other which are greater than predetermined permissible deviations and/or is adapted to signal changes in said milk flow characteristics which are greater than predetermined permissible changes.

6. An information system according to claim 5, characterized in that the signalling device generates an output signal when a deviation is greater than the permissible deviation and/or a change is greater than the permissible change.

7. An information system according to any one of the preceding claims, characterized in that the data derived from the signals relate to the time interval between the connection of a milk cluster and the beginning of the milk flow from the udder of an animal.

8. An information system according to any one of the preceding claims, characterized in that the data derived from the signals relate to the time interval between the beginning of the milk flow and the end of the milk flow.

9. An information system according to any one of the preceding claims, characterized in that the data derived from the signals relate to the maximum flow rate in a subinterval of the milk flow period.

10. An information system according to any one of the preceding claims, characterized in that the data derived from the signals relate to the amount of milk which has flowed on average during the milk flow period.

11. An information system according to any one of the preceding claims, characterized in that the data derived from the signals relate to the variation in the milk flow in time during the milk flow period.

12. An information system according to any one of the preceding claims, characterized in that the processing device comprises one or more input gates to which other parameters concerning each individual animal or group of animals can be fed.

13. An information system according to claim 12, characterized in that the processing device processes said signalled deviations and/or changes in combination with other available parameters, such as feed intake, milk yield, temperature, animal activity, milk conductivity and water intake.

14. An information system according to any one of the preceding claims, characterized in that the system further comprises a milking robot for automatically milking the animals, the milking robot comprising means for generating said signals comprising information about the milk

flow during the milking of an animal or group of animals.

15. A method for automatically obtaining data about animals in dairy farming, in which signals comprising information about a milk flow during the milking of an animal or group of animals are fed to a processing device, and the processing device derives data from the signals, stores the data and processes the data further, characterized in that deviations in the data in relation to predetermined milk flow characteristics of the relevant animal or the relevant group of animals and/or changes in said milk flow characteristics are determined, and an animal or group of animals is signalled for the purpose of watching the reproductive status and/or health status of the relevant animal or the relevant group of animals when the deviations and/or changes exceed predetermined values.

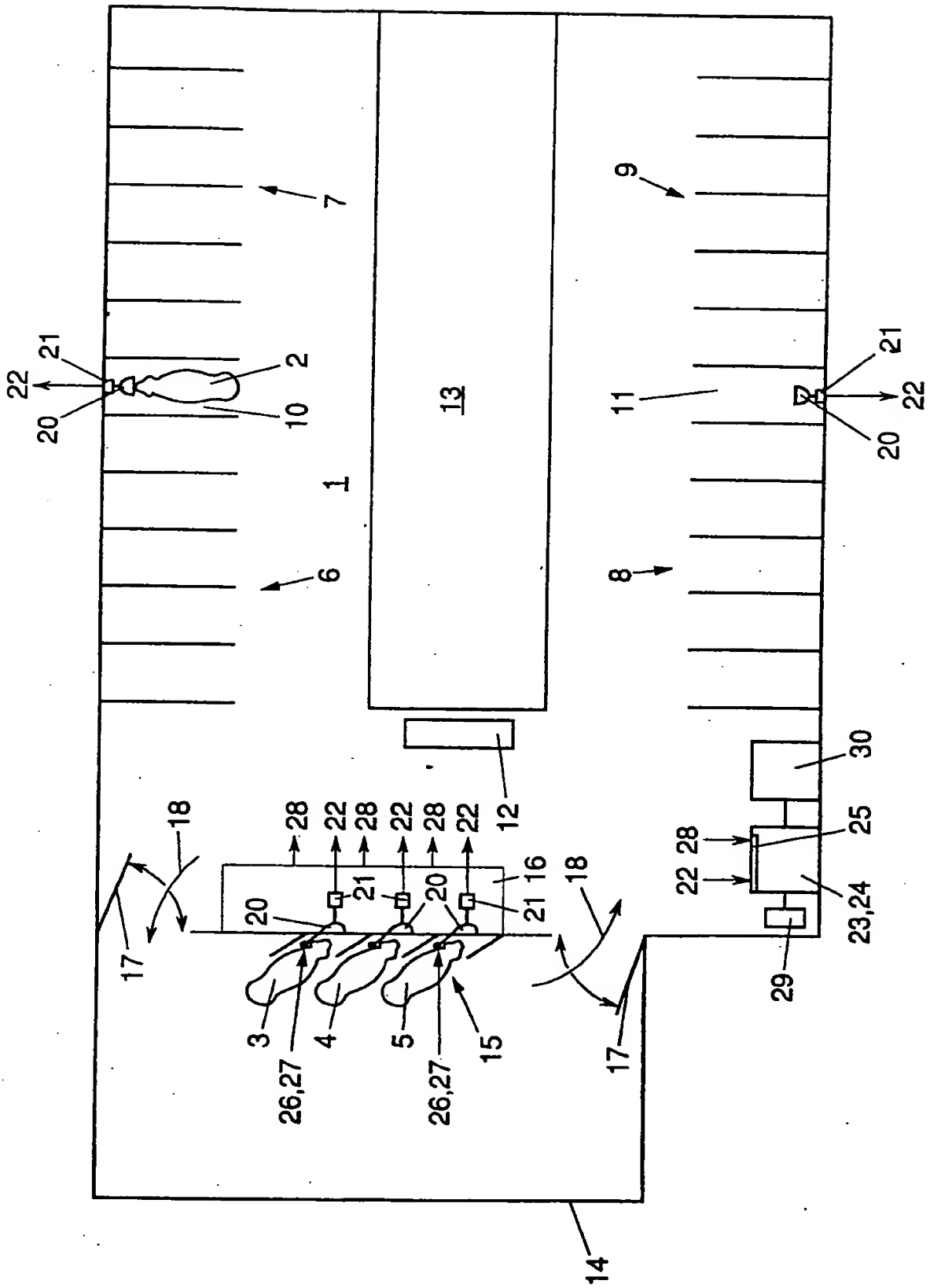
16. A method according to claim 15, characterized in that said signals are processed into statistical information for the purpose of obtaining said milk flow characteristics.

17. A method according to claim 16, characterized in that an expected value of said data is determined for the purpose of obtaining said milk flow characteristics.

18. A method according to any one of the preceding claims 15, 16, or 17, characterized by signalling deviations between the milk flow characteristics and the received data which are greater than predetermined permissible deviations and/or changes in said milk flow characteristics which are greater than predetermined permissible changes.

19. A method according to any one of the preceding claims 15-18, characterized by deriving from the signals at least one of the following data:
- data relating to the time interval between the connection of a milk cluster and the beginning of the milk flow from the udder of an animal;
- data relating to the time interval between the beginning of the milk flow and the end of the milk flow;
- data relating to the maximum flow rate in a subinterval of the milk flow period;
- data relating to the amount of milk which has flowed on average during the milk flow period; and/or
- data relating to the variation in the milk flow in time during the milk flow period.

20. A method according to any one of the preceding claims 15-19, characterized in that said signalled deviations and/or changes are processed in combination with other available parameters, such as feed intake, milk yield, temperature, animal activity, milk conductivity and water intake, for the purpose of watching the reproductive status and/or health status of the relevant animal or the relevant group of animals.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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 3590

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A,D	US-A-5 152 246 (WAKUI) * column 2; figures 1-6 *	1-9,15	A01K11/00 A01K29/00 A01J5/00
A	US-A-4 463 353 (KUZURA) * abstract * * column 10, line 21 - column 13, line 5 *	1-9,15	
A	DE-B-28 28 548 (WESTFALIA SEPARATOR AG)		
A	DE-A-36 09 275 (SCHMIDT)		
A	EP-A-0 442 383 (STIRL)		
A	EP-A-0 551 957 (C. VAN DER LELY N.V.)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

A01K
A01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 March 1995	von Arx, V

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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